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RSEARCH ARTICLE

Performance and Blood Profiles of Finisher Broilers Fed Diets Containing Graded Levels of Cashew (*Anarcadium occidentale* L.) Pulp Meal

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ABSTRACT

A 4-week feeding trial was conducted to investigate the performance and blood profiles of finisher broilers fed cashew pulp meal (CPM) based diets. 135 finisher broilers, "Arbor acre" strain was randomly allocated to five dietary treatments consisting of three replicates of 9 finisher broilers each. Five on-farm diets containing 0 (control), 10, 20, 30, and 40% CPM replacing maize coded as T1 T2, T3, T4, and T5, respectively, were formulated. All performance parameters measured were significantly different ($P < 0.05$). Final weight, daily weight gain (DWG), daily feed intake, feed conversion ratio, mortality, feed cost/kg gain (feed cost/kg gain), and cost of 1 kg feed ranged from 1042.54 to 1305.55g, 16.31 to 28.51g, 91.86 to 110.54g, 3.26 to 5.56, 0 to 22.22%, 115.43 to 135.46, and 414.23 to 611.43, respectively. Hematological profile show that packed cell volume varied from 28.67 to 31.00%, hemoglobin (Hb) 9.07 to 10.60g/dl, red blood cell 1.80 to 2.31 × 10^6/µl, white blood cell 213.13 to 223.67 × 10^3/µl, mean corpuscular volume 132.27 to 134.87 fl, means corpuscular Hb (MCH) concentration 29.80 to 31.63 g/dl, and MCH 40.10 to 41.87 pg, respectively, and were significantly ($P < 0.05$) different. Treatments showed significant difference ($P < 0.05$) all serum parameters, the obtained values were total protein 4.25–4.92 g/dl, albumin 1.73–2.37 g/dl, aspartate aminotransferase 102.33–135.67 µ/l, alanine aminotransferase 4.00–7.33 µ/l, and total cholesterol 2.37–3.73 Mmol/l. The study showed that CPM depressed live weight but did not affect birds' health even at 40% replacement of maize.

Key words: Cashew pulp meal, finisher broiler, Performance

INTRODUCTION

The poultry industry is of immense importance to the socioeconomic development of Nigeria due to its ability to provide protein at relatively shorter duration compared to other livestock species and at a relatively reduced cost. However, growth in the industry does not match population growth. The growth and development of the industry are confronted by the high cost of feed and drugs.[1] In Nigeria, maize has been widely used as the principal energy source in poultry nutrition.[2] However, the keen competition for this ingredient between man, industries, and livestock has increased the cost of this ingredient beyond the reach of the average Nigerian livestock farmers.[2] According to Apata and Ojo,[3] the high cost of compounded feed for poultry is derived largely from the exorbitant prices of feed ingredients, increasing competitive demand for them by man and animals, as well as scarcity of conventional ingredients such as maize, sorghum, groundnut cake, soybean, and fish meal. The production of the broiler is expected to increase due to the increase in current sensitization on the health implication of consuming red meat.[4] Oyewole *et al.*[5] asserted that broiler remains one of the fastest sources of readily available animal protein for human consumption due to the rapid growth, when given good nutrition and management. Hence, if the feed constraint arising from competition for feed ingredients between poultry and man is addressed, production of broiler can equally be made for export thereby reducing the demand for foreign exchange for the importation

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of frozen poultry products.[5] Due to the increasing cost of conventional feed ingredients such as maize, soybean, and groundnut cake among others, animal nutritionists have been exploring alternative potential feed ingredients which are not of any nutritional importance to man.[5] Most of these alternative feed resources are either agro-industrial by-products or waste.[2] Cashew (*Anacardium occidentale*) apple is a potential feed resource, which has been used in starter broiler production.[2] The evaluation of a cashew apple waste (CAW) that is not directly consumed by man with broiler is germane, to reduce the cost of production, without undermining the health of the birds.[2] Oke *et al*.[6] reported that the blood transports or conveys nutrients and materials to different parts of the body, therefore whatever affects the blood, nutrition or drugs will certainly affect the entire body in terms of health, growth, maintenance, and reproduction. Cashew apple (cashew pulp) in the study location is mostly often allowed to rot or constitute environmental menace after removal of the nuts.

Objectives of the study

The feeding trial sought to determine the performance and blood parameters of finisher broilers fed diets containing graded levels of cashew pulp meal (CPM) or CAW as a partial replacement for maize.

MATERIALS AND METHODS

The study was conducted the Teaching and Research Farm of Kogi State University, Anyigba in Dekina Local Government Area, Kogi State, Nigeria. The experimental site is within the southern Guinea savannah zone of Nigeria on Longitude 07^0 29'N and Latitude 07^0 11'E of the Greenwich meridian.[7] 135 4 week old broilers of Abor acre strain were allotted in a completely randomized design to five dietary treatments of three replicates each. Five on-farm formulated diets were compounded, in which CPM replaced 0%, 10%, 20%, 30%, and 40% of maize in T0, T1, T2 T3, and T4, respectively. Each treatment had 27 birds such that each replicate had nine birds which were raised on deep litter. The feeding trial lasted for 4 weeks.Feed and drinking water were provided *ad libitum,* and standard routine management practices were followed.

Experimental diets

Fresh cashew pulps were collected into clean grains bag from different cashew plantations in Dekina Local Government Area. The pulps were rinsed with clean water after which the juice expressed with the aid of hydraulic press machine. The compressed cashew pulps were spread on a clean concrete floor to dry until the pulp became crispy. The dried cashew pulps were milled such that the particles could pass through 2 mm mesh sieve.[2] The CPM was then used to substitute 0, 10, 20, 30, and 40% of dietary maize [Table 1].

Data collection

Initial weight of birds was determined by weighing the birds per replicate at the beginning of the experiment and the end. Daily feed intake (DFI) was determined by subtracting the left over from the quantity of feed offered. Feed conversion ratio (FCR) was determined by dividing intake by weight gain.[2] Economic indices estimated included the cost of producing a unit kilogram of the feed and cost of feed per kilogram weight gain. Percentage of mortality was determined as described by Oyewole *et al*.[2]

Blood collection hematological data

Blood samples were collected at the end of the trial from two birds per replicate and eight birds per treatment. The birds were bled in the morning between 06.30 and 09.00 h to avoid excessive bleeding. Blood samples were collected from the wing vein using a sterile disposable needle after sterilizing the collection site with antiseptic [9]. Samples for hematological evaluation were collected into ethylene diamine tetraacetic acid treated tubes to prevent coagulation, the hematological indices determined were packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), mean corpuscular volume (MCV), means corpuscular Hb (MCH), and mean corpuscular Hb concentration (MCHC). Blood samples for serum biochemical profile were collected into labeled sample bottles without anticoagulant.[9] Serum biochemical parameters, namely, total protein, albumin, cholesterol, alanine aminotransferase (ALT), and aspartate amino-transferase (AST), were determined as described by Schalm *et al*.[10]

Statistical analysis

All data collected were statistically analyzed using analysis of variance with the aid of SPSS statistical computer software package. Where significant effects were obtained, means were separated with the aid of the same SPSS software package using Duncan's multiple range test.

RESULTS AND DISCUSSION

Results

The performance of birds fed diets containing graded levels of CPM is shown in Table 2. All parameters measured were significantly different ($P < 0.05$). Final weight (FW), daily weight gain (DWG), DFI, FCR, mortality, feed cost/kg gain (FC), and cost of 1 kg feed ranged from 1042.54 to 1305.55 g, 16.31 to 28.51 g, 91.86 to 110.54 g, 3.26 to 6.75, 0 to 22.22%, 115.43 to 135.46, and 414.23 to 611.43, respectively.

All the hematological parameters evaluated [Table 3] were significantly ($P < 0.05$) different among the treatments. Observed PCV values ranged from 29.00% to 31.00%, Hb 9.07 to 10.60 g/dl, and RBC 1.80 × 10^6/µl to 2.32 × 10^6/µl, WBC ranged from 213.13 × 10^3 to 223.67 × 10^3/µl, MCV ranged between 132.27 and 134.87 fl, MCHC ranged between 29.80 and 31.63 g/dl, and MCH 40.10 and 41.87 pg. The result of serum biochemical response of birds is shown in Table 4. Observed results for all evaluated parameters were

Table 1: Gross composition (%) of experimental diets for finisher broilers

Ingredient	Level of inclusion of CPM %				
	T1 (0)	T2 (10)	T3 (20)	T4 (30)	T5 (40)
Maize	44.00	39.60	35.20	30.80	26.40
CPM	0.00	4.40	8.80	13.20	17.60
Maize offal	15.00	15.00	15.00	15.00	15.00
Soybean meal (full fat)	37.00	37.00	37.00	37.00	37.00
Bone meal	3.30	3.30	3.30	3.30	3.30
Methionine	0.15	0.15	0.15	0.15	0.15
Common salt	0.30	0.30	0.30	0.30	0.30
Vitamin-mineral premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Analyzed nutrient composition (%)					
Crude protein	20.74	21.70	20.62	21.93	24.04
Crude fiber	4.14	4.35	4.50	5.30	5.89
Ether extract	5.76	5.79	5.98	5.80	5.60
Ash	9.03	9.39	9.49	11.47	12.20
Nitrogen-free extract (%)	51.56	49.97	51.65	47.41	44.54
Calculated nutrients/energy					
**Calcium	1.02	1.00	0.99	0.98	0.97
**Phosphorous	0.50	0.49	0.48	0.47	0.46
*Kcal/kgME	3064.22	3045.83	3080.90	2964.27	2924.25

**Calculated without contributions from CPM. *Calculated ME=37× %CP+81 × %EE+35.5×%NFE.[8] CPM: Cashew pulp meal

Table 2: Performance of finisher broilers fed diets containing CPM

Parameter	Level of inclusion of CPM %						
	T1 (0)	T2 (10)	T3 (20)	T4 (30)	T5 (40)	SEM	LOS
Initial weight (g)	503.70	500.00	511.11	504.40	496.30	13.45	NS
FW (g)	1305.55^a	1155.56^c	1211.57^b	1042.54^d	1112.50^c	32.92	*
DWI (g)	28.51^a	22.62^b	23.33^b	16.31^d	18.86^c	1.52	*
DFI (g)	91.86^c	96.73^b	95.62^b	110.54^a	97.96^b	2.64	*
FCR	3.26^a	4.40^c	4.10^b	6.75^e	5.56^d	0.67	*
Mortality (%)	0.00^d	7.41^b	3.70^c	22.22^a	0.00^d	2.61	*
Cost of feed/kg (NN)	135.46^a	130.46^b	125.45^c	120.44^d	115.43^e	1.89	*
Cost of feed/kg gain (NN)	418.79^a	574.03^b	414.23^a	611.43^c	601.78^c	36.48	*

^{abcde}Means with different superscripts on the same row differ significantly ($P<0.05$). NS: Not significant ($P>0.05$), SEM: Standard error of mean, CPM: Cashew pulp meal

Table 3: Hematological parameters of finisher broilers fed cashew pulp meal based diets

Parameter	Level of inclusion of CPM %						
	T1 (0)	T2 (10)	T3 (20)	T4 (30)	T5 (40)	SEM	LOS
PCV (%)	29.00^{bc}	28.67^{c}	30.00^{ab}	29.00^{bc}	31.00^{a}	0.60	*
Hb (g/dl)	10.60^{a}	9.07^{b}	10.00^{a}	9.20^{b}	10.30^{a}	0.29	*
RBC($\times10^{6}$/µl)	1.80^{c}	2.17^{b}	2.21^{b}	2.21^{b}	2.32^{a}	0.37	*
WBC ($\times10^{3}$/µl)	217.00^{c}	213.13^{e}	223.67^{a}	214.13^{d}	221.10^{b}	2.74	*
MCV (fl)	134.87^{a}	132.27^{c}	131.77^{d}	133.07^{b}	132.30^{c}	0.66	*
MCHC (g/dl)	31.63^{a}	30.37^{c}	30.20^{d}	30.87^{b}	29.80^{e}	0.23	*
MCH (pg)	41.87^{a}	40.10^{c}	41.33^{b}	41.33^{b}	40.17^{c}	0.44	*

SEM: Standard error of Mean, LOS: Level of significance, NS: Not significant (P>0.05), *Significant (P< 0.05), ^{abcd}Means with different superscripts on the same row differ significantly (P<0.05), PCV: Packed cell volume, WBC: White blood cell, Hb: Hemoglobin, RBC: Red blood cell, MCV: Mean corpuscular volume, MCHC: Mean corpuscular hemoglobin concentration, MCH: Mean corpuscular hemoglobin

Table 4: Serum biochemistry of finisher broilers fed CPM diets

Parameter	Level of inclusion of CPM %						
	T1 (0)	T2 (10)	T3 (20)	T4 (30)	T5 (40)	SEM	LOS
Total protein (g/dl)	4.85^{a}	4.25^{c}	4.65^{b}	4.92^{a}	4.60^{b}	*	0.08
Albumin (g/dl)	2.10^{b}	2.37^{a}	1.73^{c}	2.10^{b}	2.17^{a}	*	0.07
AST (µ/l)	121.00^{b}	113.33^{c}	135.67^{a}	120.33^{b}	102.60^{d}	*	3.34
ALT (µ/l)	7.00^{b}	6.67^{c}	4.00^{e}	7.33^{a}	5.67^{d}	*	0.39
Total cholesterol (Mmol/l)	2.73^{d}	2.37^{e}	3.37^{b}	3.73^{a}	3.03^{c}	*	0.14

^{abcde}Means on the same row with different superscripts are significantly different (P<0.05). SEM: Standard error of mean, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, LOS: Level of significance

statistically significant difference ($P < 0.05$) among treatments. Total protein ranged from 4.25 g/dl to 4.92 g/dl, albumin 1.73 g/dl to 2.37 g/dl, AST 102.33 µ/l to 135.67 µ/l, ALT 4.00 µ/l to 7.33 µ/l, and total cholesterol 2.37 Mmol/l to 3.73 Mmol/l.

Discussion

Observed values for the FW of birds showed that the control diet (0% CPM) had the highest weight and those on 30% CPM inclusion the poorest. DWG followed a similar pattern as the FW. Observed results showed that CPM inclusion in the diet depressed DWG and consequently live weight of broilers. The trend of weight gain may suggest the efficiency of utilization of CPM by the birds, suggesting that the control diet which is maize-based was better utilized. Kadirvel *et al.*[11] had reported a progressive decrease in the weight gain of broilers fed CPM at 15% and above. Depression in the life weight of starter broilers and cockerel chicks fed CPM-based diets relative to maize have also been reported.[2,12] It may, therefore, imply that the nutritional quality of the maize-based diet was better. The birds tended to consume CPM based diets than the control (0% CPM), an indication that CPM inclusion in the diet did not undermine the acceptability of the diets. It is also probable that the birds ate to satisfy their energy requirement. FCR followed a similar trend as that of feed intake (the higher the feed intake, the poorer the FCR), with birds in the control group having the best value (3.26). Kadirvel *et al.*[11] reported that an increase in feed intake resulted in poor feed efficiency of broilers on CPM. CPM depressed FCR in starter broilers and cockerel chicks.[2,12] Mortality was recorded in all CPM group except 40% CPM (T5), no mortality was recorded in the control group. The observed trend for mortality did not suggest that cashew pulp inclusion in the diets was toxic to the birds as there was no case of mortality in 40% CPM groups. Cost of feed/kg significantly ($P < 0.05$) declined as the rate of inclusion of CPM inclusion in the diet increased, this reduction may be as a result of the reduced cost of CPM relative to the cost of maize. Earlier workers[2,12] had reported that CPM inclusion in the diets resulted in the cheaper feed. Cost of feed per kg gain was significantly ($P < 0.05$) different across the treatment means with birds on T4 (30% CPM) having the highest cost of 611.43 whereas those on T3 (20% CPM) had the least cost. This indicates that the most economic inclusion of CPM was at 20%.

Observed PCV value ranging from 29.00% to 31.00% fell within the range of 28–40% reported for healthy birds[13] and 28.67–37.00% by Oyewole

et al.[2] with starter broilers on CPM-based diets. This value indicated that the birds were healthy and were not affected adversely by the feeding of the experimental diets. Observed Hb value range of 9.07–10.60 g/dl is within the range of 9.8–13.00 g/dl[14] and 8.77–12.10[2] for healthy birds. It is an indication that the birds had sufficient vitamins and minerals from the diets which helped them to synthesize sufficient Hb which aids oxygen and carbon dioxide transportation in the blood. For birds fed CPM based diets the value for WBC ranged from 213.13 × 10^3 to 223.67 × 10^3/µl and is within the range of 197.03 × 10^3/µl–229.17 × 10^3/µl reported by Oyewole *et al*.[2] for starter broilers fed CPM diets but is <237.00 × 10^3–258 × 10^3/µl reported by Comfort and Idorenyin[15] for finisher broilers fed yam peel meal based diets. This trend in WBC does not suggest any negative effect of CPM on the immune system of the birds. Observed values for MCV ranged between 132.27 and 134.87fl and are >100–129.00 fl reported by Mitruka and Rawnsley[16] for healthy birds but within 128.23–136.00 fl[2] for starter broilers fed CPM diets. The observed values for MCHC ranged between 29.80 and 31.63 g/dl and falls within the range of 30.97–32.27 g/dl reported by Oyewole *et al*.[2] for healthy starter broilers fed CPM based diets. The observed value for MCH ranged from 40.10 to 41.87 pg and is within the range of 41.30–42.70 pg reported by Oyewole *et al*.[2] Values observed for MCHC, MCH and MCV did not suggest that the birds were anemic. Hence, birds on CPM receive adequate vitamins and minerals necessary for hematopoiesis and were, therefore, not anemic. Observed total protein values of 4.25g/dl–4.92g/dl were lower than the reference range of 5.6–5.9 g/dl for birds reported by Ayoola *et al*.,[17] but are within the range of 3.25–7.61 g/dl observed by Ayoola *et al*.[18] Oyewole *et al*.[2] had reported 3.97–4.80 g/dl with starter broilers fed CPM diets. Observed values are therefore normal and suggest that the experimental birds were not under stress likely due to dehydration, disease, or malnutrition.[19] Total protein has been reported as an indicator of the protein retained in the animal body[20,21] and is reported to depend on the quantity and quality of dietary protein.[22,23] Observed albumin range of 1.73–2.37 g/dl is higher than the range of 1.25–2.20 g/dl observed by Akinmutimi and Onen[24] for finisher broilers fed yam peel meal as a replacement for maize. Oyewole *et al*.[2] had reported 1.70–1.83 g/dl with starter broilers fed CPM diets. Observed values appear normal and suggest that substitution of maize with CPM did not adversely affect the nutritive quality of the experimental diets. Albumin value may suggest good health; elevated serum albumin may indicate poor health and is a predictor of a bad outcome.[25] The AST values range from 102.33 µ/l to 1x/l is higher than the range of 101.57–121.70 µ/l reported by Abdel-Fattah *et al*.,[26] and different from 115.00 µ/l to 121.33 µ/l reported by Oyewole *et al*.[2] for starter broilers fed diets containing CPM. The ALT values range from 4.00 µ/l to 7.33 µ/l is lower than the observed values of 18.99–20.06 µ/l by [26] but close to 6.33–10.00 µ/l.[2] The trend of results observed for both AST and ALT suggest that the birds did not experience hepatic or renal damage due to the diets. Cholesterol (Mmol/l) increased significantly ($P < 0.05$) from 2.37 Mmol/l in birds on T2 (10%) to 3.73 Mmol/l in birds on T4 (40%). Total cholesterol observed 2.37–3.73 Mmol/l is similar to 2.88–3.46 Mmol/l reported by Abdulazeez *et al*.[27] for broiler chickens fed graded levels of baobab (*Adansonia digitata* L.) seed meal indicating that CPM did not affect the absorption of dietary lipids and cholesterol which is required for the synthesis of a number steroid hormones, bile production, and building of body tissues among other.

CONCLUSION

Inclusion of CPM in broiler finisher diet, even at 10% resulted in reduction in live weight due to poor feed conversion. However, the reduction in FC was achieved, and the resultant feed did not adversely affect the health of the birds.

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